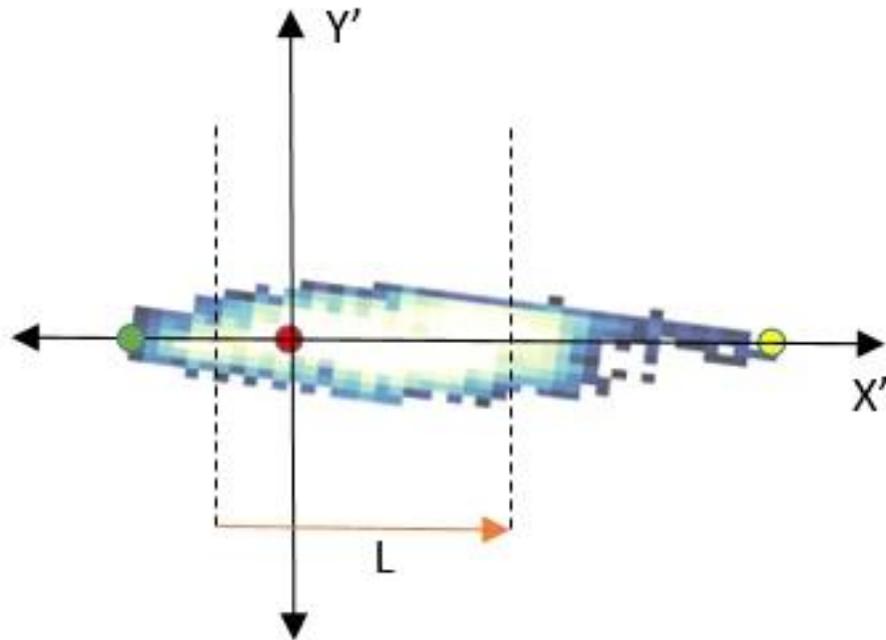


Source-Attributable,
Quantitative Results from a
Basin-Wide Survey of
Methane Emissions
Elena Berman, PhD.



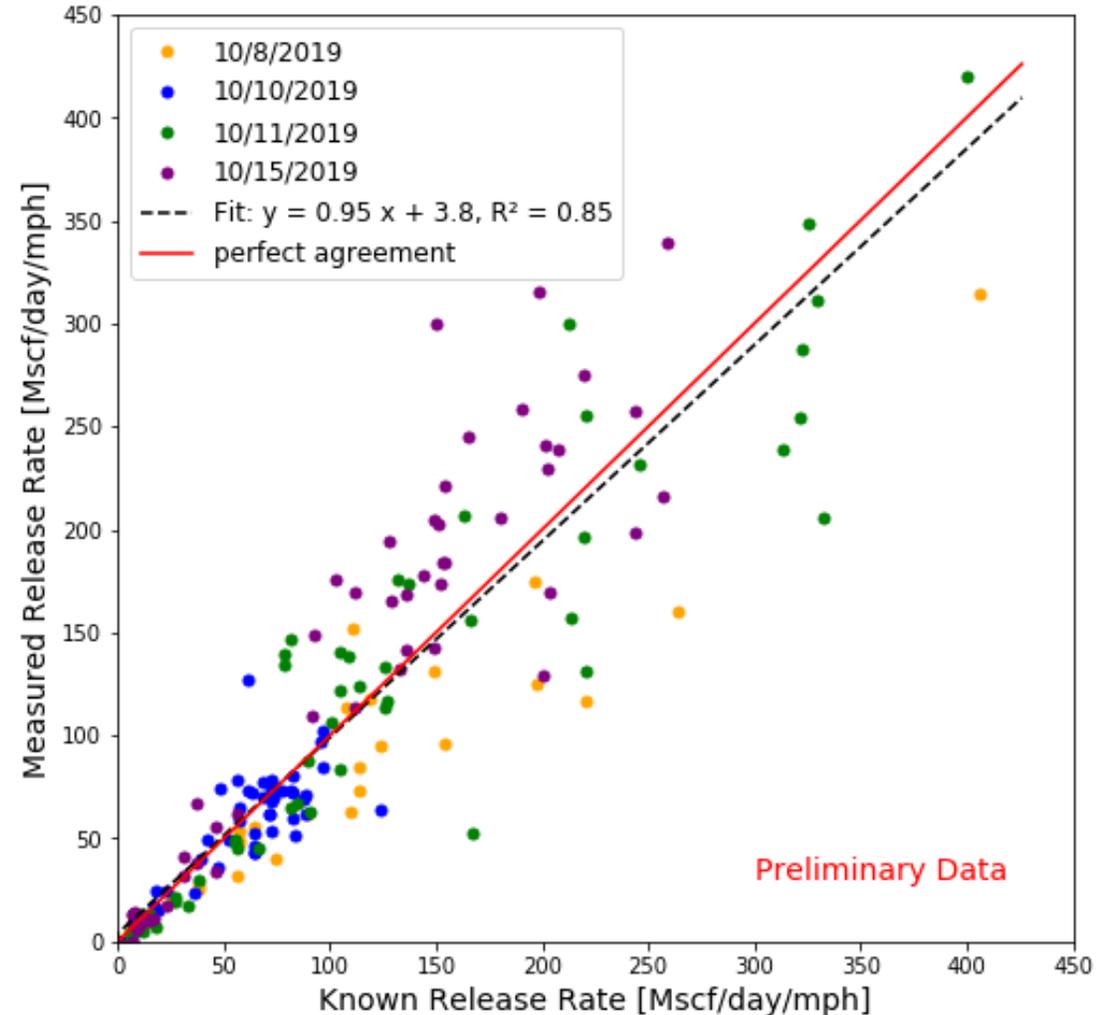
Kairos sensor pods deploy on light aircraft, imaging, quantifying, and source-attributing methane from 3,000 feet, covering 100-150 square miles per day.

Plume Quantification



Methane is quantified from the image of the entire plume using a cross-sectional flux method.

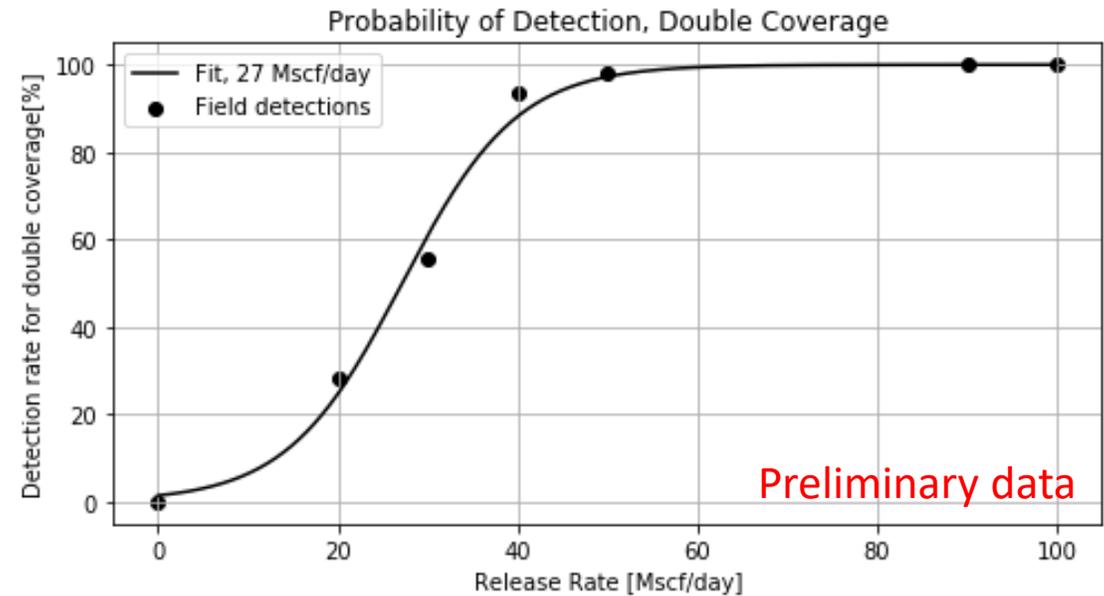
Single-blind Stanford University Validation Experiment



What Proportion of the Methane Released is Observed?

EDF April 2019 Report: Explore New Mexico's oil and gas pollution

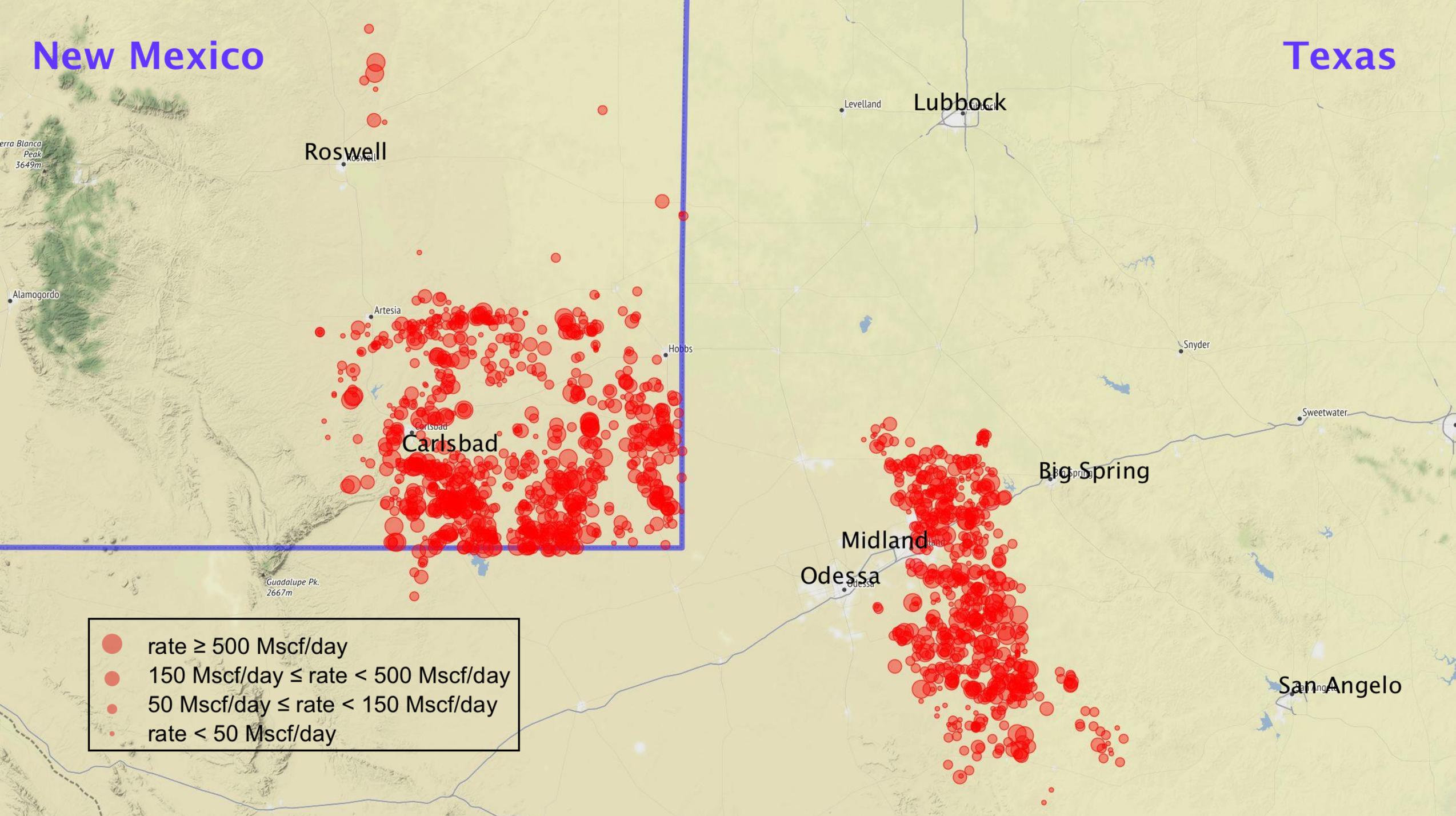
- EDF Inspected 94 upstream sites in NM Permian
 - No new data for San Juan Basin or midstream
- Fitted log-normal distribution predicts:
 - 80% of methane from just 3% of sites, those emitting ≥ 41.6 Mscf/day
- The Kairos survey results generally agree with the EDF report



Approx. 80%

New Mexico

Texas



Roswell

Levelland

Lubbock

Artesia

Hobbs

Snyder

Carlsbad

Sweetwater

Big Spring

Midland

Odessa

San Angelo

- rate ≥ 500 Mscf/day
- $150 \text{ Mscf/day} \leq \text{rate} < 500 \text{ Mscf/day}$
- $50 \text{ Mscf/day} \leq \text{rate} < 150 \text{ Mscf/day}$
- rate < 50 Mscf/day

2019 New Mexico Permian Survey

Scope

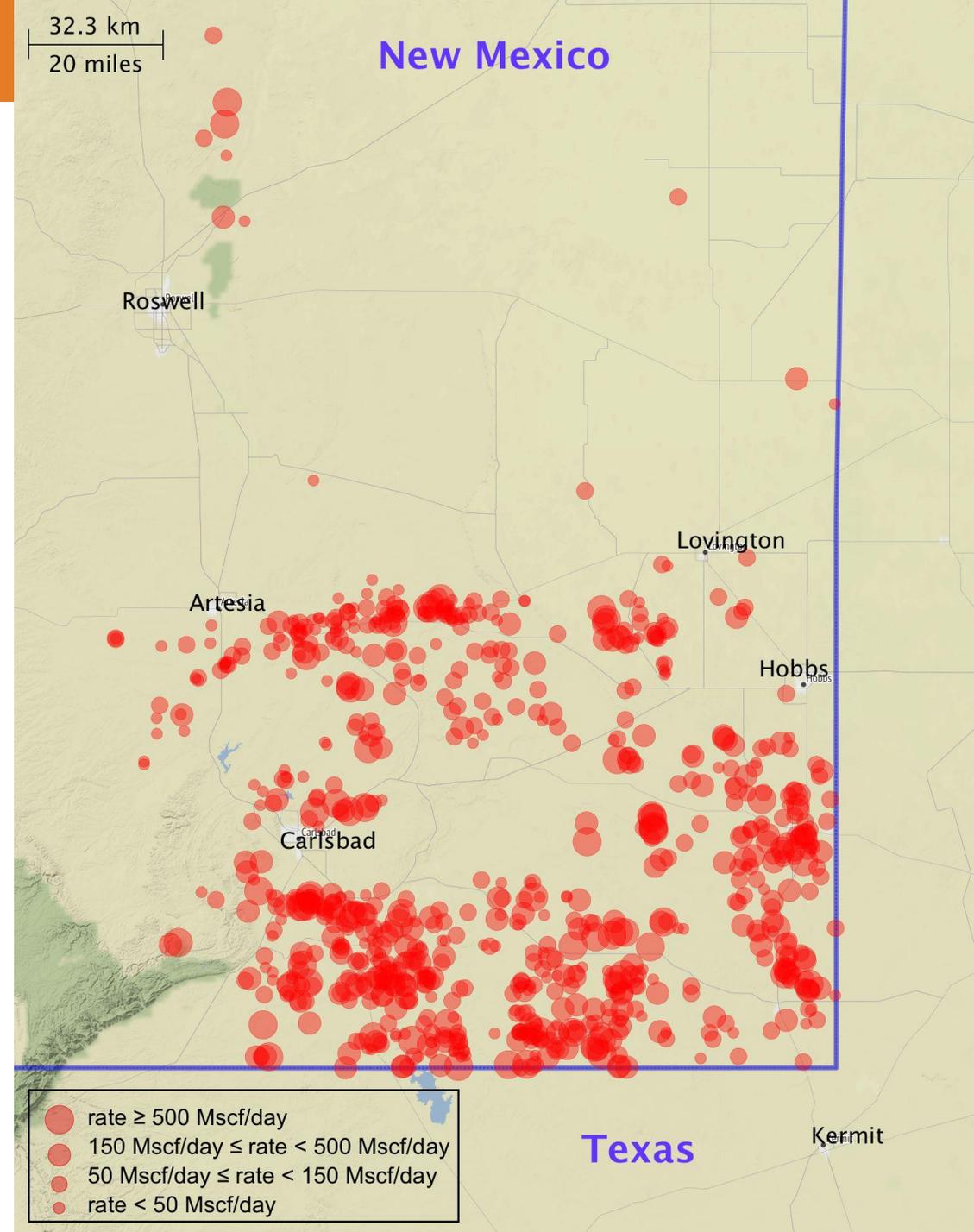
- 10,859 square miles
- 30,000+ active wells
- 10,000+ miles of NG pipelines

Status (as of 10/30/19)

- ~88% of surface facilities surveyed
- ~74% of gas pipeline length surveyed

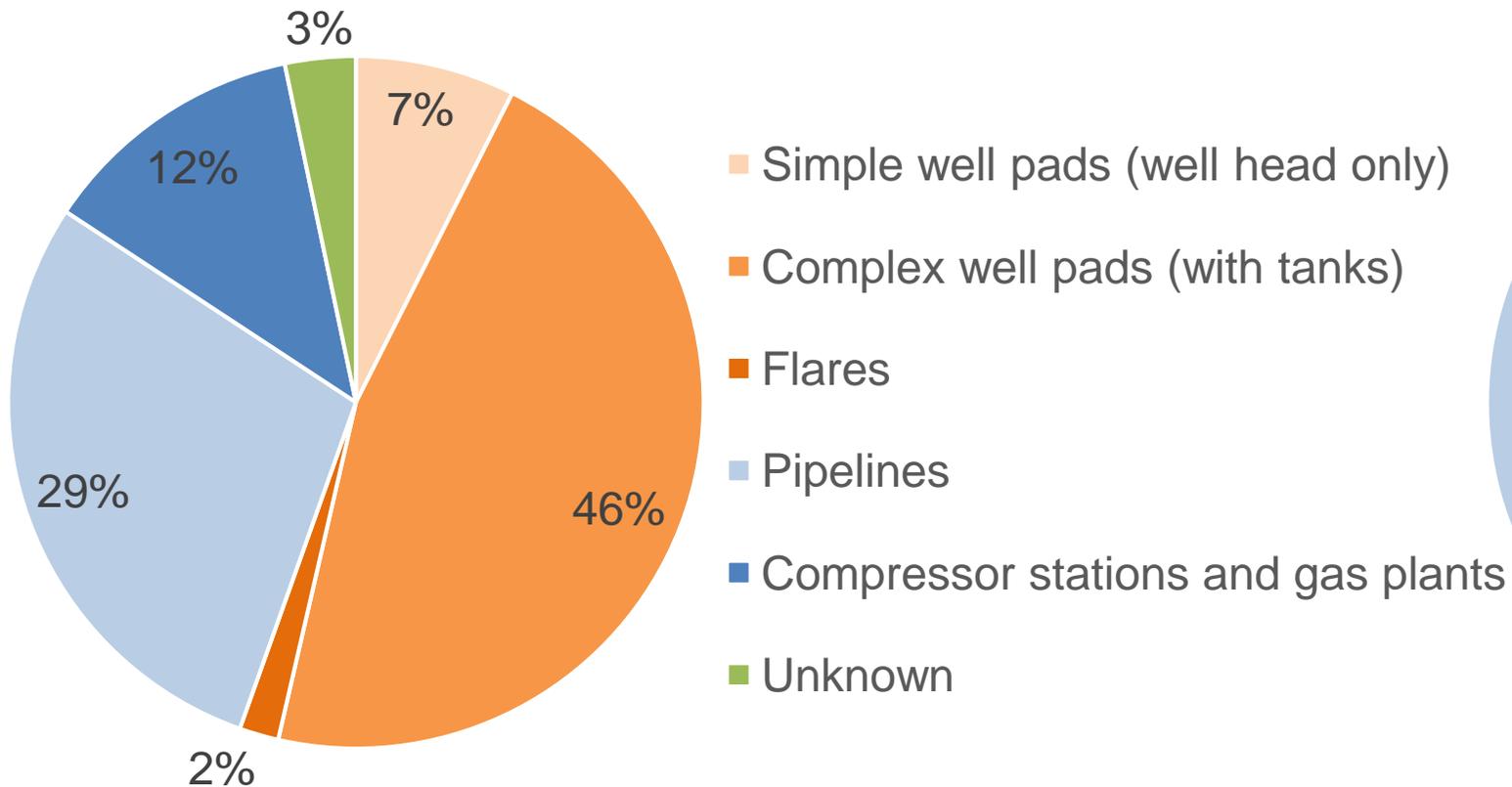
Findings

- 969 emissions sources detected
- Median: 88 Mscf/day
- 90th percentile: 444 Mscf/day

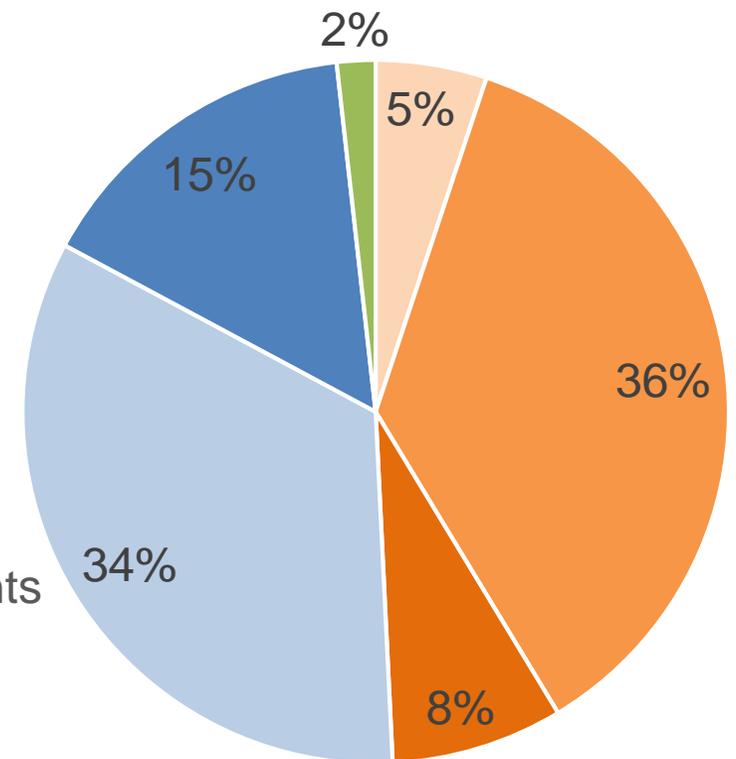


Methane Emissions by Source Category

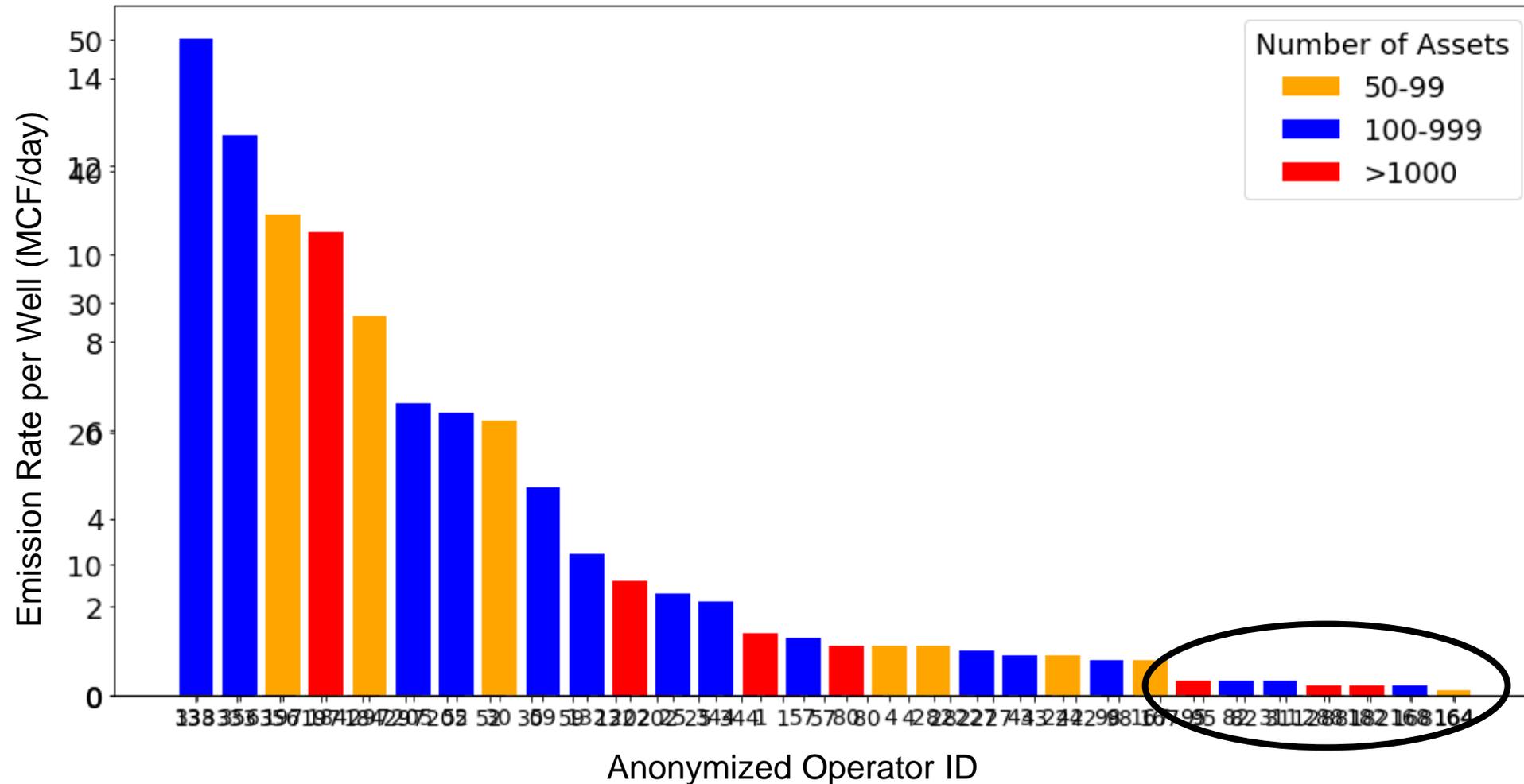
Share by Number of Sources



Share by Methane Volume



Upstream Emissions by Operator*



If rate/well for all operators equaled that of the best 20% → 89% reduction in measurable emissions

* Operators with at least 50 surveyed wells

Conclusions

- Basin-wide survey capability gives a new and unique view of emissions data
 - 969 large emissions observed from > 26,500 surface facilities and ~10,000 miles of pipeline
 - First empirical data on the fat tail of the distribution, no bootstrapping required
- 49% of emissions from midstream overall, 34% from pipelines
- If rate/well for all operators equaled that of the best 20% → 89% methane reduction from upstream, 83% from midstream
- Final analysis of this data will be published in conjunction with Stanford University

